

What is claimed is:

1. A matrix comprising:
 - a substrate capable of providing attachment of a heparin-binding peptide;
 - 5 a peptide comprising a binding domain that binds heparin with high affinity; heparin or a heparin-like polymer; and
 - a protein growth factor or peptide fragment thereof having a domain that binds heparin with low affinity.
2. The matrix of claim 1 wherein the growth factor or peptide fragment thereof
10 that binds heparin with low affinity is further defined as eluting from a heparin-affinity column at a NaCl concentration of about 25 mM to about 140 mM.
3. The matrix of claim 1 wherein the domain of the growth factor or peptide
fragment thereof is further defined as comprising a length of about 8 to 30 amino acid
residues comprising at least 2 basic amino acid residues, a ratio of basic to acidic
15 amino acid residues of at least 2, and a ratio of hydrophobic amino acid residues to
basic amino acid residues of at least 0.67.
4. The matrix of claim 3 wherein the basic amino acid residue is K or R.
5. The matrix of claim 3 wherein the acidic amino acid residue is further defined
as D or E.
- 20 6. The matrix of claim 3 wherein the hydrophobic amino acid residue is further
defined as A, V, F, P, M, I, or L or C when C is involved in a disulfide bond.
7. The matrix of claim 1 wherein the growth factor or peptide fragment thereof is
neurturin, persephin, IGF-1A, IGF-1 β , EGF, NGF β , NT-3, BDNF, NT-4, TGF- β 2,
TGF- β 3, or TGF- β 4.

8. The matrix of claim 7 wherein the growth factor or peptide fragment there is further defined as neurturin or a peptide fragment thereof.
9. The matrix of claim 7 wherein the growth factor or peptide fragment thereof is further defined as persephin or a peptide fragment thereof.
- 5 10. The matrix of claim 7 wherein the growth factor or peptide fragment thereof is further defined as IGF-1A or a peptide fragment thereof.
11. The matrix of claim 7 wherein the growth factor or peptide fragment thereof is further defined as IGF-1 β or a peptide fragment thereof.
12. The matrix of claim 7 wherein the growth factor or peptide fragment thereof is further defined as EGF or a peptide fragment thereof.
- 10 13. The matrix of claim 7 wherein the growth factor or peptide fragment thereof is further defined as NGF β or a peptide fragment thereof.
14. The matrix of claim 1 wherein the growth factor or peptide fragment thereof is further defined as NT-3 or a peptide fragment thereof.
- 15 15. The matrix of claim 1 wherein the growth factor or peptide fragment thereof is further defined as BDNF or a peptide fragment thereof.
16. The matrix of claim 1 wherein the low heparin-binding affinity growth factor protein or peptide fragment thereof is further defined as NT-4 or a peptide fragment thereof.
- 20 17. The matrix of claim 1 wherein the low heparin-binding affinity growth factor protein or peptide fragment thereof is further defined as TGF- β 2 or a peptide fragment thereof.

18. The matrix of claim 1 wherein the low heparin-binding affinity growth factor protein or peptide fragment thereof is further defined as TGF- β 3 or a peptide fragment thereof.
19. The matrix of claim 1 wherein the low heparin-binding affinity growth factor protein or peptide fragment thereof is further defined as TGF- β 4 or a peptide fragment thereof.
20. The matrix of claim 1 wherein the substrate comprises fibrin.
21. The matrix of claim 1 wherein the substrate comprises a synthetic polymer hydrogel.
- 10 22. The matrix of claim 1 wherein the peptide comprising a domain that binds heparin with high affinity is further defined as eluting from a heparin-affinity column at not less than 140 mM NaCl.
23. The matrix of claim 1 wherein the peptide comprising a domain that binds heparin with high affinity is further defined as comprising SEQ ID NO: 1, SEQ ID NO:2, SEQ ID NO:3, SEQ ID No:4, or SEQ ID NO:5.
- 15 24. The matrix of claim 1 wherein the heparin or heparin-like polymer has a molecular weight between about 3,000 and 10,000,000 Daltons.
25. The matrix of claim 1 wherein the heparin-like polymer is a polysaccharide having a molecular weight between about 3,000 and 10,000,000 Daltons, and having at least one negative charge per two saccharide rings and no more than one positive charge per ten saccharide rings.
- 20 26. The matrix of claim 1 wherein the heparin-like polymer is dextran sulfate, chondroitin sulfate, heparan sulfate, fucan, alginate, or a derivative thereof.

27. The matrix of claim 1 wherein the molar ratio of heparin or heparin-like polymer to growth factor is at least one.
28. The matrix of claim 1 wherein the molar ratio of covalently attached peptide having a binding domain that binds heparin with high affinity to heparin or a heparin-like polymer is at least one.
29. A matrix comprising:
a substrate capable of providing attachment of heparin or a heparin-like polymer;
heparin or a heparin-like polymer; and
a growth factor or peptide fragment thereof having a domain that binds heparin with low affinity.
30. The matrix of claim 29 wherein the low heparin-binding affinity of the growth factor protein or peptide fragment thereof is further defined as eluting from a heparin-affinity column at a NaCl concentration of about 25 mM to about 140 mM.
31. The matrix of claim 29 wherein the growth factor protein or peptide fragment thereof comprises of a domain length of about 8 to 30 amino acid residues comprising at least 2 basic amino acid residues, a ratio of basic to acidic amino acid residues of at least 2, and a ratio of hydrophobic amino acid residues to basic amino acid residues of at least 0.67, which growth factor protein further elutes from a heparin-affinity column at a NaCl concentration less than about 140 mM.
32. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as neurturin, persephin, IGF-1A, IGF-1 β , EGF, NGF β , NT-3, BDNF, NT-4, TGF- β 2, TGF- β 3, TGF- β 4, or a peptide fragment thereof having a domain that binds heparin with low affinity.

33. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as neurturin or a peptide fragment thereof having a domain that binds heparin with low affinity.
34. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as persephin or a peptide fragment thereof having a domain that binds heparin with low affinity.
35. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as IGF-1A or a peptide fragment thereof having a domain that binds heparin with low affinity.
36. The matrix of claim 29 wherein the growth factor or peptide fragment thereof is further defined as IGF-1 β or a peptide fragment thereof having a domain that binds heparin with low affinity.
37. The matrix of claim 29 wherein the growth factor or peptide fragment thereof is further defined as EGF or a peptide fragment thereof having a domain that binds heparin with low affinity.
38. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as NGF β or a peptide fragment thereof having a domain that binds heparin with low affinity.
39. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as NT-3 or a peptide fragment thereof having a domain that binds heparin with low affinity.
40. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as BDNF or a peptide fragment thereof having a domain that binds heparin with low affinity.

41. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as NT-4 or a peptide fragment thereof having a domain that binds heparin with low affinity.
42. The matrix of claim 29 wherein the low heparin-binding affinity growth factor
5 or a peptide fragment thereof is further defined as TGF- β 2 or a peptide fragment thereof having a domain that binds heparin with low affinity.
43. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as TGF- β 3 or a peptide fragment thereof having a domain that binds heparin with low affinity.
- 10 44. The matrix of claim 29 wherein the growth factor or a peptide fragment thereof is further defined as TGF- β 4 or a peptide fragment thereof having a domain that binds heparin with low affinity.
45. The matrix of claim 29 wherein the substrate comprises fibrin.
46. The matrix of claim 29 where the substrate comprises collagen.
- 15 47. The matrix of claim 29 wherein the substrate comprises hyaluronic acid or a hyaluronic acid derivative.
48. The matrix of claim 29 wherein the substrate comprises a synthetic polymer hydrogel.
49. The matrix of claim 29 wherein the heparin or heparin-like polymer has a
20 molecular weight between about 3,000 and 10,000,000 Daltons.
50. The matrix of claim 29 wherein the heparin-like polymer is a polysaccharide having a molecular weight between about 3000 and 10,000,000 Daltons and having at least one negative charge per 2 saccharide rings and no more than 1 positive charge per 10 saccharide rings.

51. The matrix of claim 29 wherein the heparin-like polymer is dextran sulfate, chondroitin sulfate, heparan sulfate, fucan, alginate, or a derivative thereof.
52. The matrix of claim 29 wherein a molar ratio of heparin or heparin-like polymer to growth factor or a peptide fragment thereof is included in the matrix of at least 1.
53. A matrix comprising:
a substrate capable of supporting the attachment of a cell, wherein said substrate comprises heparin or a heparin-like polymer bound thereto; and
growth factor or a peptide fragment thereof having a domain that binds heparin with low affinity,
wherein under physiological conditions the low heparin-binding affinity growth factor is released by degradation of a component of the matrix or by dissociation of the growth factor from the heparin or heparin-like polymer.
54. The matrix of claim 53 wherein the substrate comprises fibrin.
55. The matrix of claim 53 wherein the heparin or heparin-like polymer is non-covalently attached to the substrate.
56. The matrix of claim 53 wherein the heparin or heparin-like polymers is covalently attached to the substrate.
57. A vascular graft comprising a matrix capable of supporting cell adhesion, said matrix comprising bound heparin or heparin-like polymer and a growth factor having low binding affinity for heparin.
58. An article for treatment of dermal wounds comprising a matrix capable of supporting cell adhesion, said matrix comprising bound heparin or heparin-like polymer and a growth factor having low binding affinity for heparin.

59. The article of claim 58, wherein the growth factor is TGF- β 3.

60. An article of manufacture comprising a matrix capable of supporting cell adhesion, said matrix comprising bound heparin or heparin-like polymer and a growth factor or peptide fragment thereof having low binding affinity for heparin.

5 61. An implantable sterilized composition comprising a matrix capable of supporting cell adhesion, said matrix comprising bound heparin or a heparin-like polymer and a growth factor or peptide fragment thereof having low binding affinity for heparin.

62. A method for providing controlled release of growth factor comprising:

10 preparing a matrix comprising a growth factor having a domain with low affinity for binding heparin and bound heparin or heparin-like polymer; and
placing the matrix on a wound in need thereof.

63. The method of claim 62, wherein the growth factor is released by degradation of a component of the matrix or by dissociation of the growth factor from the heparin
15 or heparin-like polymer.